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AIRCRAFT AVIONICS NONSUPPORTABILITY AND MICROCIRCUIT OBSOLESCENCE

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ABSTRACT

The declining military budget has resulted in service life extensions for many weapons systems. Conversely, mission essential systems, such as the avionics suite, on naval aircraft extend, must contend with the scheduled phase out of subcomponents and microcircuits over the next few years. This unplanned obsolescence will have a costly impact on the ability of naval aviation to maintain weapons systems in a high state of operational readiness. Identifying the size of this problem is made more complex because provisioning data (for older systems) is often incomplete or inaccurate, making it difficult to cross obsolete part numbers (P/N's) to specific system applications. This paper describes a proactive process for analyzing avionics system supportability issues involving microcircuit obsolescence and other factors, such as mission criticality, reliability, supply and demand, and aircraft allowance. Based on this analysis, a comprehensive, life cycle model is developed to predict time critical mission degraders and offers solutions for solving supportability issues.

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INTRODUCTION

The process is currently being used to successfully identify and manage nonsupportability and obsolescence issues pertinent to avionics systems installed in the S-3 aircraft weapons system. Procedures outlined in this paper are not intended to be a "cure-all" for all nonsupportability and obsolescence problems. They are offered as an organized step-by-step means to ensure that microcircuit and other obsolescence issues are addressed in the most timely and cost effective manner. Analysis is based on identifying aircraft avionics nonsupportability and microcircuit obsolescence issues, assessing their impact, and taking necessary action to minimize impact on a particular program. Information contained in this paper was obtained through personal experience, review of various Navy documentation dealing with obsolescence, and discussions with Navy and contractor personnel involved in the analysis of avionics nonsupportability/microcircuit obsolescence problems.

THE CURRENT MICROCIRCUIT OBSOLESCENCE MANAGEMENT PROCESS

The process for managing microcircuit obsolescence in naval aviation weapons systems is comprised of four distinct functions:

- a. Microcircuit configuration assessment
- b. Microcircuit obsolescence vulnerability assessment
- c. Microcircuit obsolescence monitoring/notification
- d. Microcircuit obsolescence problem resolution

MICROCIRCUIT CONFIGURATION ASSESSMENT

Before any aviation program can identify and address potential obsolescence problems, a functional Configuration Management (CM) system must be in place. Two key functions are particularly important.

- A configuration baseline containing an inventory of installed microcircuits by Weapons Replaceable Assembly (WRA) and Shop Replaceable Assembly (SRA) must be resident.
- A program that develops a material "Bad Actor" list based on a reliability assessment program which regularly evaluates both performance and consumption data involving installed microcircuits must be in place.

Accurate identification of material suggests a direct relationship between the item of interest (such as a microcircuit), and the equipment that it is installed in (end item, WRA, SRA, etc.). There are data bases containing adequate relational information (parts to equipment install cross references) on parts that have a National Stock Number (NSN) assigned. However, there is no complete data base available for material identified only by P/N (nonstock numbered items). Sometimes this disconnect occurs because the procuring activity receives notification of obsolescence from the original equipment manufacturer (OEM) for a P/N without reference to the equipment it is installed in. Whatever the cause, it poses a significant handicap. If no linkage can be made between the P/N item and the end item (WRA, SRA, etc.), no action can be taken to address the obsolescence situation until the procuring activity makes an attempt (often at a much later date) to reprocure the end item. Conversely, when the platform (weapons system) has a complete data base of microcircuit P/N's, linkage can be established early enough to allow proactive decisions to be made. A collateral issue is the failure of Navy to initially (or ever) procure a particular system's microcircuit inventory. When MIL-STD-2096A, "Microcircuit Data Requirements" is cited on a contract for equipment or a system, then

microcircuit P/N data exists. Unfortunately, 2096A data requirements have often been removed from procurement requests, resulting in no data being obtained.

The dynamic aviation material support environment guarantees that rapidly changing technology will create obsolescence issues in every weapons system. As the service life of weapons systems is extended, this problem is exacerbated. The prudent configuration manager will have a responsive reliability, maintainability, and supportability (RM&S) program to regularly review CM data and identify material "Bad Actors." The criteria used to establish S-3 "Bad Actors" included:

- Minimum 50% drop in reliability (analysis of mean flying hour between failure (MFHBF) data for the period 1976-1991).
- Low and dropping MFHBF today (less than 100 hrs.).
- High and rising total costs (Aviation Depot Level Repairable + Input/Output level \$750,000/yr.).
- High and rising supply items (25,000 hrs./yr.).
- System/WRA downing aircraft (Nonmission Capable Supply/Partial Mission Capable Supply).

A partial list of data sources utilized to create the "Bad Actor" list include the following:

- Naval Aviation Maintenance Material Management (AV-3M) data.
- Equipment Control Analysis records.
- Navy Inventory Control Point (formerly Aviation Supply Office) review.

MICROCIRCUIT OBSOLESCENCE VULNERABILITY ASSESSMENT

There are a number of government facilities and private companies that have expertise analyzing avionics systems for current and future obsolescence. Most of them

provide detailed analysis of a systems current and future obsolescence problems, alternate source information, and microcircuit future availability forecast. These types of reports are useful for looking at new systems being developed and determining future supportability requirements. Another approach to assessing avionics obsolescence vulnerability is the use of RM&S data bases. By assessing the RM&S characteristics of a WRA, an informed vulnerability to obsolescence assessment can be made (i.e., if a system is very reliable or a large number of spares is present, obsolescence might not be a concern).

MICROCIRCUIT OBSOLESCENCE MONITORING AND NOTIFICATION

There are numerous data systems designed to alert the manager to potential system material or microcircuit obsolescence. The following are major systems utilized by the Navy and many DoD activities.

- Microcircuit Obsolescence Management data
- Government Industry Data Exchange Program
- Transition Analysis of Component Technology, Inc.
- Defense Electronic Supply Center alert notices.

Each system has pro's and con's, however all provide at least two essential services. All data base systems analyze current microcircuit production status. Likewise, each provides Naval Air Systems Command personnel with obsolescence notices involving previously identified systems. All of these systems can be accessed via modem.

MICROCIRCUIT OBSOLESCENCE PROBLEM RESOLUTION

Once an obsolescence situation is identified, the manager has a number of resolution options available:

- a. Life of Type (LOT) Buy - Involves purchasing a supply of items to support total demands for the anticipated service life of impacted systems/equipment.
- b. Substitution - Involves analyzing item characteristics and attempting to locate a similar part with an acceptable degree of nonconformance.
- c. After Market Manufacturers - If part specifications and test, acceptance, and related technical data are complete and available, after market manufacturers may support continued production of obsolete items.
- d. Emulation - The process of developing form, fit, and function replacements for obsolete microcircuits using state-of-the-art material design and processing techniques. Emulated items are not intended to be substitutes, but rather valid alternate parts for the nonavailable components; however, a risk does exist in that emulated parts may fail to meet certain unspecified performance characteristics of the original item, and thus suitability for all applications may not be guaranteed.
- e. Reclamation - This alternative should be considered primarily to resolve crisis situations (i.e., short term resolution alternative), or in cases where remaining LOT demand is minimal. It will be most effective when a supply of end items has been identified and resources are available for recovery, testing, repackaging, and storage. Potential sources for this alternative include; beyond economical repair equipment at depot repair facilities, surplus and stored material removed due to modernization programs, or items resident within deactivated or decommissioned units.
- f. Redesign - This alternative involves designing out obsolescence items via engineering changes at various system indenture levels, with the goals of enhancing system performance and improving reliability and maintainability. An

increasingly common type of redesign, known as Technology Insertion, entails development of fit-transparent replacements for aging electronic technologies primarily at the component and board level.

- g. Reverse Engineering - Reverse engineering is the process of developing exact replicas of candidate items through review of available technical data and physical disassembly and analysis of item components. It may be appropriate when the government does not possess sufficient technical data or data rights to support reprocurement; the goal is to cultivate qualified alternate sources and provide the basis for competitive acquisitions through development of a full procurement data package.

THE S-3 AVIONICS NON-SUPPORTABILITY AND MICROCIRCUIT OBSOLESCENCE PROGRAM

The Naval Air Warfare Center Aircraft Division (NAWCAD), Patuxent River, Maryland, (Design, Interface and Logistics Support Department) has provided the S-3 Program Office with microcircuit obsolescence support over the last 2 years. This comprehensive program was designed and implemented using the previously mentioned four-phase approach to solving avionics nonsupportability and microcircuit obsolescence problems. The first phase included the establishment of a complete P/N data base for all avionics in the S-3 aircraft and a "Bad Actor" identification program.. Microcircuit P/N for all avionics systems and WRA's on the aircraft were obtained by researching Work Unit Code manuals, Illustrated Parts Breakdowns, and source control drawings. Armed with pertinent data, analysts determine if suspected obsolete P/N's will have an affect on S-3 avionics systems. The second phase analyzed avionics systems for current or future obsolescence problems. In this case, the definition of obsolete means that the OEM has indicated that they will no longer make a particular microcircuit. For each mission critical avionics system to be researched, a list of WRA's and installed microcircuits was compiled. A Microcircuit Technology Assessment (MTA) report was prepared to

evaluate the supportability of a WRA, and each one is categorized as obsolete, near the end of its life cycle, or low risk factor.

In addition to the MTA, a list of primary and alternate NSN's associated with each obsolete microcircuit was produced. This list is provided to the Navy Inventory Control Point for validation against quarterly demand and on-hand quantities. The third phase utilized this quarterly demand and on-hand data to prioritize avionics systems for which complete obsolescence assessment was warranted. A number of questions must be answered to determine the evaluation priority for a particular avionics system. For example:

- "Is the avionics system mission critical?" Obviously, if the system is not mission critical there is less concern about a potential obsolescence problem.
- "Is the system highly reliable?" A reliable system will need fewer replacements and be less likely to be effected by obsolescence problems.
- "What is the supply and demand profile for this system?" If demand is low and a large supply of spare assets is present, obsolescence will have little or no impact on a systems supportability.

One way to examine the supply and demand profile of an avionics system is by constructing a waterfall chart such as that shown in figure 1.

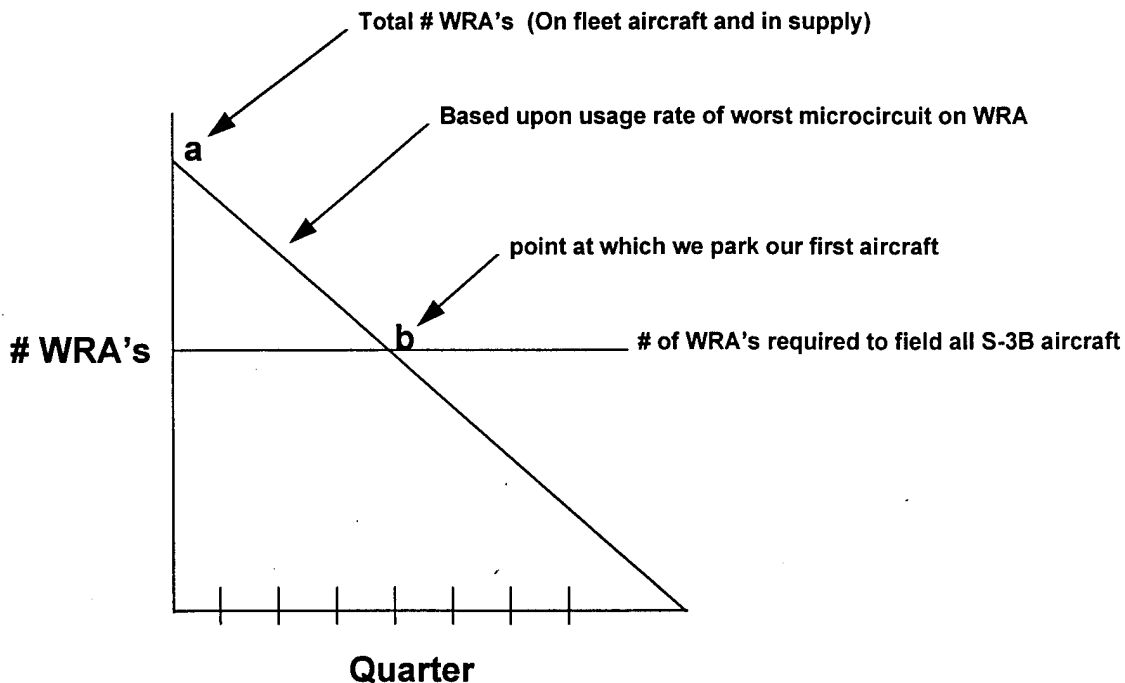


Figure 1

Determining the minimum number of systems required to field all aircraft is the first step in creating this data profile. If operational requirements exceed the minimum number of systems, some aircraft may need to be parked. Next, the total number of assets (WRA's) existing, both on the aircraft and in the supply system, is determined. The usage rate of the worst microcircuits in that system (obtained from the MTA reports previously discussed), determines the slope of the line. The intersection of this line with the minimum number of required systems gives a general idea of the seriousness of the supportability problem. If this intersection occurs in the year 2020, and the platform is being retired in 2015, a supportability problem does not exist. Conversely, if the intersection occurs in the near future, supportability becomes a hot topic and the issue must be addressed as soon as possible. Based upon the answers to these and other questions, mission critical avionics systems (and supporting WRA's, SRA's, etc.) are prioritized for further analysis. The Design, Interface and Logistics Support Department is in the fourth phase on all systems included on the S-3 priority list. Options previously

discussed for solving obsolescence problems are being investigated on a system-by-system basis and acted upon. Because of the dynamic nature of advancing technology, it is important to remember that completion of phase four will not insure elimination of obsolescence problems. The Configuration Manager must be committed to a life cycle obsolescence assessment program involving both current systems and new systems being designed or developed. If done correctly, future obsolescence problems can be anticipated, thereby eliminating the need for costly redesign and life of type buys.

CONCLUSION

Obsolescence is a dynamic problem. Determining that a system is supportable today does not insure it will be supportable tomorrow. Constant vigil and assessment is necessary to guard against the large cost of failing to solve obsolescence problems in a timely fashion. Many tools and organizations exist that can help a program manager do this. The careful application of the process described in this paper will provide the configuration manager with tools and a network to produce the most cost effective and efficient obsolescence management program possible.

ABOUT THE AUTHOR

Don is head of the Antisubmarine Aircraft Logistics Division, NAWCAD, Patuxent River, Maryland. He has over 13 years of experience in the fields of logistics, system safety engineering, and reliability and maintainability test and evaluation. He has earned a B.S. in Safety from the Indiana University of Pennsylvania, a M.S. in Systems Management from the University of Southern California and a M.S. in Aeronautical Engineering from the Naval Post Graduate School.